

# Lawrence Livermore Laboratory

POSTACO - A POST-PROCESSOR FOR SCALAR,  
TWO-DIMENSIONAL FINITE ELEMENT CODES

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18708

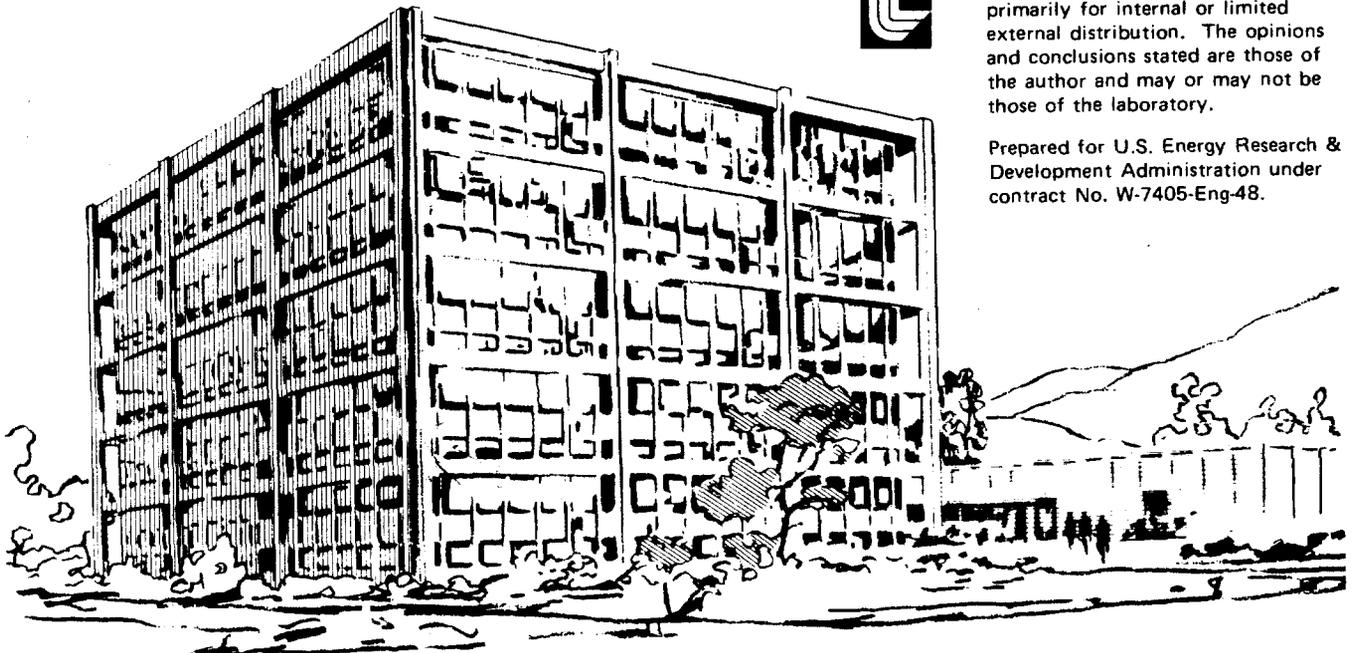
November 1978

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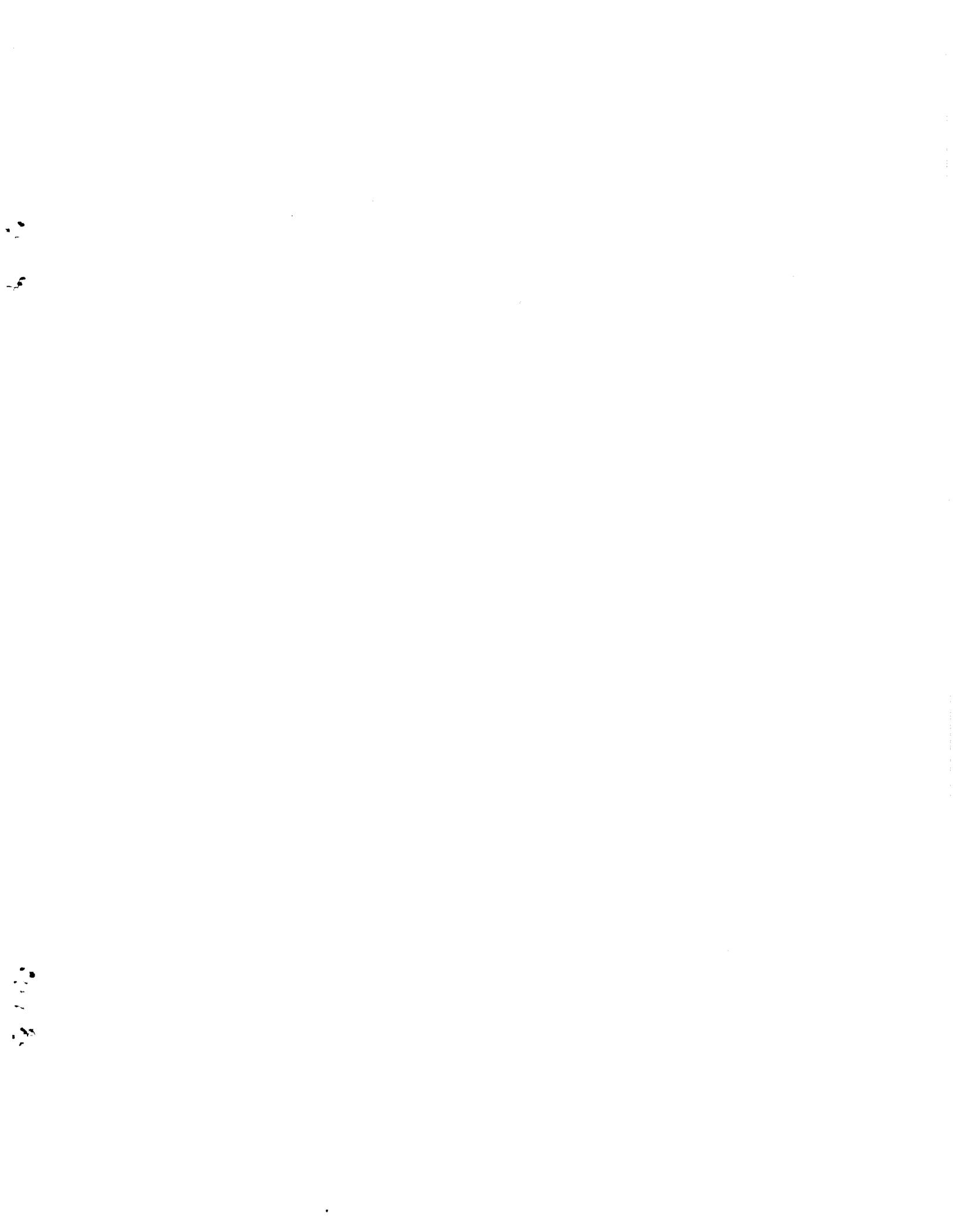
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## INTRODUCTION

POSTACO is a graphics post-processor for scalar, two-dimensional finite element codes. It has the capability of producing a variety of graphical output including contour plots, profile plots, and nodal time history plots.

POSTACO was originally developed as a companion to the heat transfer code TACO. However, it may be used to plot data from any scalar code which produces binary plot files with the appropriate format. It can also be used to plot nodal and element time histories from data produced by the structural analysis code SAP4 after that data is processed by the SARG code (2).

The following sections of this report explain the capabilities, the execution, and the output of POSTACO. A detailed user's guide is provided and an example illustrating most of the features of POSTACO is included. The format of the binary plot files read by POSTACO is described in the Appendix.

## CAPABILITIES

POSTACO has the following capabilities:

1. Geometric plots with material outlines, meshes, node numbers, element numbers, and material numbers in a variety of combinations.
2. Contour plots with material outlines at selected times.
3. Profile plots showing variation of temperature (or other function) along straight lines defined by either end point coordinates or nodal points.
4. Plots of nodal point time histories or the difference between two nodal time histories. Up to ten time histories may be included on a single plot. Either linear or log scales may be used for either axis. In addition, time histories may also be "printed" along with the plots.
5. A variety of graphics output formats are available through the use of utility routines UXRJ (3) and UXFR (4).
6. Dynamic memory allocation.

## EXECUTION

POSTACO is available on the LLL OCTOPUS system and is normally executed via teletype. It resides in GLGLIB and can be obtained with EXE by

EXE GLGLIB POSTACO DR. / t v

It is executed with

POSTACO infile,plotfile,uxfile,BOX ann id / t v

where infile is the name of the input file described in the USER'S GUIDE, plotfile denotes the root name of the familed binary plot files, and uxfile denotes the name to be given to the "UXDD80" graphics files produced by POSTACO. After the word "BOX", the ann denotes the users box number and id denotes the output identifier to be used for the graphics output. If the familed binary plot files were, for example

PLOT1, PLOT2, PLOT3,...

the word "PLOT" would be used for plotfile. In the case of uxfile the graphics files will have sequential letters and digits beginning with A80 appended. For example if uxfile is "UFILE" the UXDD80 files will be named

UFILEA80, UFILEA81, UFILEA82,...

The entries infile, plotfile, and id must be eight characters or less. Entry uxfile is limited to seven characters or less.

Dropouts are permitted on the execution line as illustrated in the following examples:

EXECUTION(cont'd.)

POSTACO infile,plotfile,BOX ann id / t v

POSTACO ,,plotfile,uxfile / t v

POSTACO ,,,uxfile,BOX ann id / t v

POSTACO infile,BOX ann id / t v

If infile is omitted, the name "POSTIN" is assumed. If plotfile is omitted, "TACOPLOT" is assumed. If uxfile is omitted, the name "U" is assumed. If the word "BOX" does not appear on the execution line, the user will be prompted for the box number and identifier.

#### GRAPHICAL OUTPUT

POSTACO produces UXDD80 graphics files. These files may be output in a variety of graphical formats with utility routines UXRJ (3) and UXFR (4). RJET plots (Versatec and wide Versatec) can be obtained with UXRJ. UXFR will produce several different types of output including 35mm and 16mm (movie) black-and-white film, hardcopy (11 inch photo-typemaster film), and 48x and 24x microfiche.

Graphics files produced by POSTACO may be viewed on the TMDS with utility routine UXTV (3). In addition, the utility routine UXEDIT (5) can be used to make changes in pictures from the UXDD80 files.

All UXDD80 files produced by POSTACO contain information for producing 35mm and 16mm color film on the FR80 system via UXFR (4). At present, all color selections are made internally by POSTACO. Future modifications will include choice of colors by the user. Consult the author for details.

## USER'S GUIDE

### 1. TITLE CARD

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1-60	6A10	Heading to appear on plots	1,2

- NOTES: 1. If heading is left blank, the original heading in the plot file (see Appendix) will be used.
2. As many data cases as desired may be executed sequentially. Each case must begin with this title card. Execution is terminated when columns 1-4 contain the word "STOP" or when an end of file is reached.

## 2. CONTROL CARD

For each entry on this card where a "1" is given, the described plot(s) will be produced.

<u>Columns</u>	<u>Format</u>	<u>Description</u>	<u>Note</u>
2	I1	Material outlines	
4	I1	Mesh without numbers	
6	I1	Mesh with material numbers	
8	I1	Mesh with element numbers	
10	I1	Mesh with node numbers	
12	I1	Mesh with node and element numbers	
14	I1	Contour plots (e.g., isotherms)	
16	I1	Time history plots	
18	I1	Time history "printouts"	1
20	I1	Profile plots	
22	I1	Box with scale around geometry plots	2

- NOTES: 1. If this option is selected, a table of values of function (e.g., temperature versus) time will be "printed" into the graphics file for each node for which a time history is requested.
2. Selection of this option produces a frame with scales around all geometric plots.

### 3. SCALE CARD

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1-10	E10.0	Scale factor for time (DEFAULT=1.0)	
11-10	E10.0	Scale factor for primary variable (e.g., temperature) (DEFAULT=1.0)	
21-30	E10.0	Scale factor for length (DEFAULT=1.0)	

#### 4. LABEL CARD

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1-20	2A10	Label for time axis (DEFAULT = "TIME")	
21-40	2A10	Label for ordinate of curves (DEFAULT = "TEMPERATURE")	
41-60	2A10	Label for abscissa of profile plots (DEFAULT = "DISTANCE")	

### 5. GEOMETRY CARD

Omit if only time histories are to be plotted.

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1-10	E10.0	Number of characters per line on mesh plots (DEFAULT = 300.0)	1
11-20	E10.0	RC, r- or x-coordinate of center of plot zone	2
21-30	E10.0	ZC, z- or y-coordinate of center of plot zone	2
31-40	E10.0	DEL. The plot zone is a square defined by (RC ± DEL, ± ZC DEL).	3
41-45	I5	Node number of the node at center of plot (NODEC)	2
46-50	I5	ISYM. If equal to 1 geometric plots are reflected about the z-axis (vertical axis)	
51-55	I5	Number of materials to be included in geometric plots (NUMMAT)	4

- NOTES: 1. The number of characters per line can be any value greater than 2.0. Adjusting this value will allow node, element, and material numbers to be scaled so that they may be seen clearly in fine meshes (this may require zooming with UXTV or UXEDIT).
2. If NODEC ≠ 0, RC and ZC will be replaced by the coordinates of node NODEC.
3. If DEL = 0 the entire body will be plotted.
4. If NUMMAT = 0, all materials will be included in geometric plots (provided they lie inside the plot zone).

6. MATERIAL NUMBER CARD(S)

Omit if NUMMAT = 0 (Card No. 5) or if only time histories are to be plotted.

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1-80	16I5	Material numbers of materials to be included in geometric plots.	1

NOTE: 1. Repeat this card as many times as necessary in order to list all desired materials.

### 7. CONTOUR PLOT CARD

Omit if no contour plots are desired.

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1- 5	I5	Plot time sample rate for contour plots (DEFAULT=1)	
6-10	I5	Number of contour intervals desired ( $\leq 20$ )	
11-20	E10.0	Minimum contour level	1
21-30	E10.0	Maximum contour level	1
31-40	E10.0	Number of characters per line for contour labels (DEFAULT = 100.0)	2
41-45	I5	Contour line code (LINEC) LINEC = 0: dotted lines LINEC = 1: solid lines	
46-50	I5	Minimum and maximum value code (MIMX) MIMX = 0: not plotted MIMX = 1: plotted	3

- NOTES: 1. If minimum and maximum contour levels are not specified, POSTACO will automatically select minimum and maximum levels based on the extreme values of the data for each contour plot. In this case the contour levels will generally be different at different times.
2. If it is desired to eliminate contour labels, the number of characters per line may be specified as a large number ( $\geq 5000.0$ ).
3. If MIMX=1 the minimum, maximum, and average values of the function being plotted will be written on the plots. In addition, an "0" and an "X" will be plotted at the points where the minimum and maximum values occur.

### 8. PROFILE PLOT DATA

Omit if no profile plots are desired.

#### Card 1

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1- 5	I5	Number of separate lines along which values are to be plotted (NSP)	1
6-10	I5	Plot time sample rate for profile plots (DEFAULT=1)	
11-15	I5	Profile plot code (MAPP) MAPP = 0: no grid on plots MAPP = 1: grid on plots	
16-20		Line type code (LINEPR) LINEPR=0: Labels (letters) on curves LINEPR=1: No labels	

NOTE: 1. If NSP is positive the endpoints of the profile lines are described by their coordinates (Card 2A) and if NSP is prefixed by a negative sign, the endpoints are specified by their nodal point numbers (Card 2B).

PROFILE PLOT DATA(cont'd.)

Card 2A (NSP>0)

One card for each profile line (columns 1-5 of Card 1)

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1-10	E10.0	x- or r-coordinate of beginning point	
11-20	E10.0	y- or z-coordinate of beginning point	
21-30	E10.0	x- or r-coordinate of end point	
31-40	E10.0	y- or z-coordinate of end point	
41-50	E10.0	Lower limit for ordinate of profile plots	1
51-60	E10.0	Upper limit for ordinate of profile plots	1

Card 2B (NSP<0)

One card for each profile line (columns 1-5 of Card 1)

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1- 5	I5	Node number of beginning point	
6-10	I5	Node number of end point	
11-20	E10.0	Lower limit for ordinate of profile plots	1
21-30	E10.0	Upper limit for ordinate of profile plots	1

NOTE: 1. If no limits are given for the ordinates, POSTACO will calculate them so that they span all the data being plotted.

### 9. TIME HISTORY DATA

Omit if no time history plots are desired.

#### Card 1

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1- 5	I5	NT, number of separate plots with time history curves ( $NT < 10$ ). (Each separate plot can have up to 10 curves).	
6-45	8I5	Temperature versus time plot scale options. As many as eight may be chosen from the following (DEFAULT=5):  1 : linear-linear 2 : log-log 3 : linear-log                   with grid 4 : log-linear 5 : linear-linear 6 : log-log 7 : linear-log                   without grid 8 : log-linear	
46-50	I5	Line type code (LINET) LINET=0: Labels (letters) on curves LINET=1: No labels.	1
51-55	I5	Node or element label code (ILABEL) ILABEL=0: "NODES" label ILABEL=1: "ELEMENTS" label	

NOTE: 1. Normally time history plots will have numbers of points for which time histories are plotted labeled as "NODES". However, some SAP4 data processed by SARG, is element data and setting ILABEL=1 allows this data to be labeled as such (i.e., "ELEMENTS").

Card 2

Repeat NT times

<u>Columns</u>	<u>Format</u>	<u>Entry</u>	<u>Note</u>
1-50	10I5	Node numbers to be included on the same time history plot	1,3
51-60	E10.0	Lower limit for ordinate of this plot	2
61-70	E10.0	Upper limit for ordinate of this plot	2
71-80	E10.0	Upper limit for abscissa (time axis) of this plot.	

- NOTES: 1. Up to 10 nodes may have their time histories plotted on a single curve. The node numbers may appear in any order on the card. However, a blank field will terminate the node number list.
2. If no limits are given for the ordinates, POSTACO will calculate them so that they span all the data being plotted.
3. If only two node numbers are included and the second node number is negative, the difference between the two nodes will be plotted.

### EXAMPLE

The following example illustrates most of the features of POSTACO.

#### INPUT FILE

EXAMPLE FOR POSTACO

```
1 0 1 1 1 0 1 1 1 0 1
  1.0      1.0      1.0
TIME (SEC)      TEMPERATURE (DEG. C) DISTANCE (M)
200.0      0.0      0.0      0.0      0      0      0
  5      9      30.0      110.0      100.0      0      0
  2      5      4
106      1
106      -1
                                0.0      140.0      0.0
                                0.0      70.0      0.0
```

EXAMPLE FOR POSTACO

```
0 0 0 0 0 0 0 0 0 1 1
  1.0      1.0      1.0
TIME (SEC)      TEMPERATURE (DEG. C) DISTANCE (M)
100.0      0.0      0.0      0.0      0      0      0
 -1      5      0      0
196      421      0.0      140.0
STOP
```

#### RESULTS

The results produced by the above input file are shown on the following pages. These graphical results were output with the "HARDCOPY" option in UXFR (4).

PLOTS CREATED BY POSTACO

COMPILED 11/21/78

REFERENCE -

W. E. MASON,  
POSTACO - A POST-PROCESSOR FOR SCALAR,  
TWO-DIMENSIONAL FINITE ELEMENT CODES,  
UCID-17979

EXAMPLE FOR POSTACO

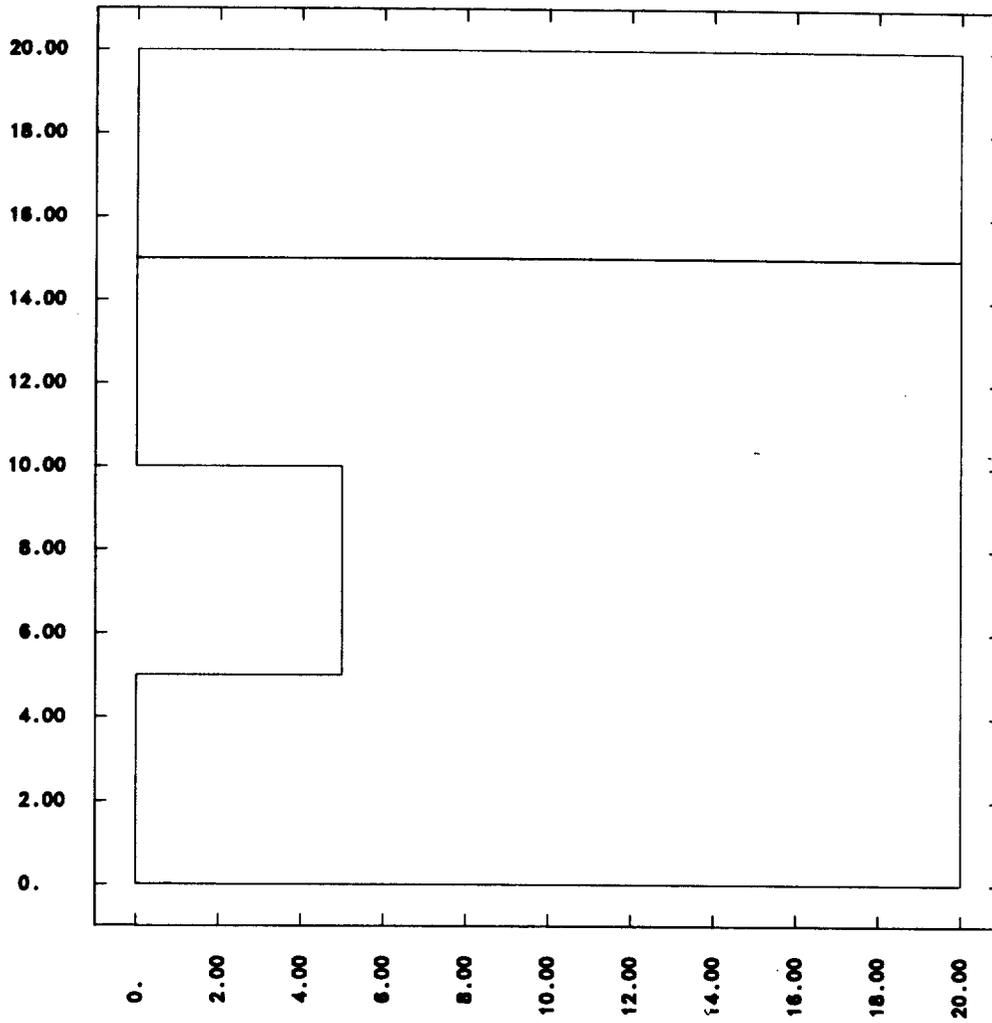
18:52:37U 10/21/78 TACO:V1. C:09/19/78

1 0 1 1 1 0 1 1 1 0 1

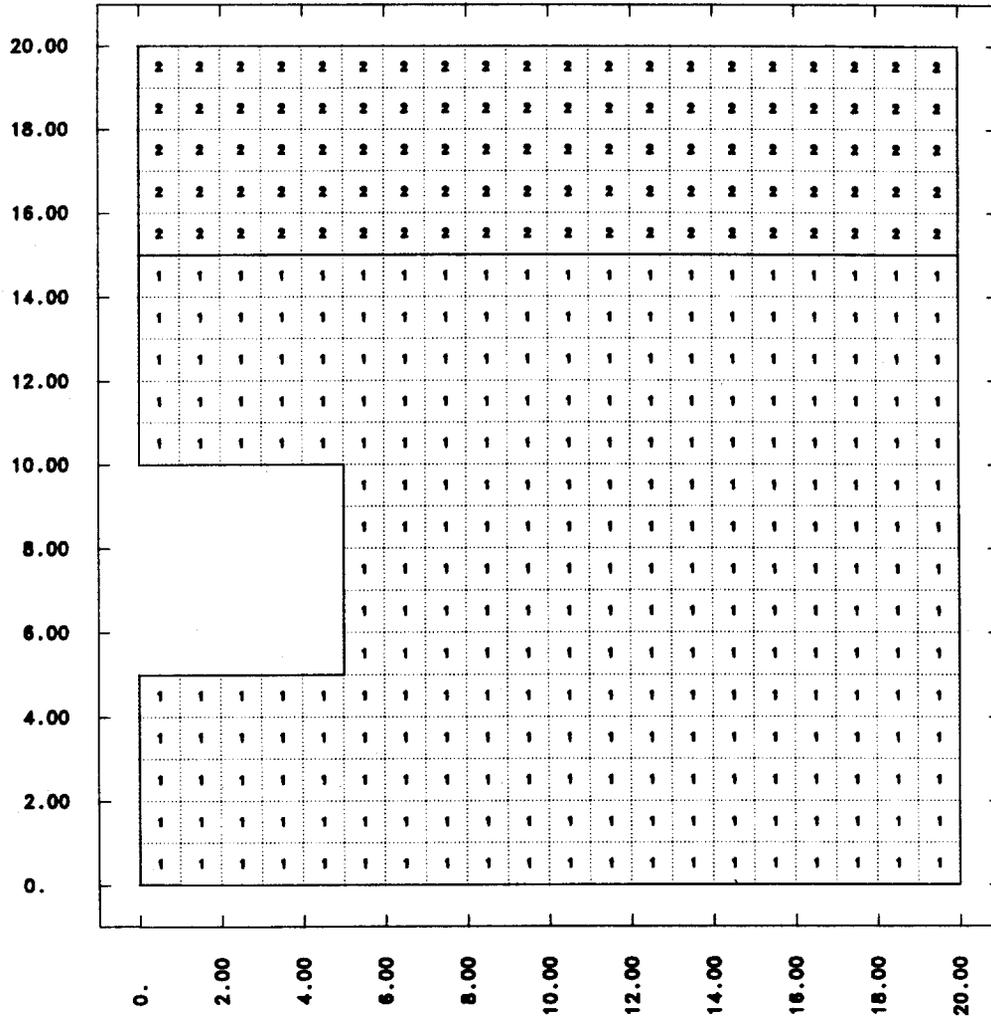
1.00E+00 1.00E+00 1.00E+00

TIME (SEC)	TEMPERATURE (DEG. C)		DISTANCE (M)			
2.00E+02	0.	0.	0.	0	0	0
5 9	3.00E+01	1.10E+02	1.00E+02	0	0	
2 5	4 -0	-0 -0	-0 -0	-0	0	0
106 1	-0 -0	-0 -0	-0 -0	-0	-0	0.
106 -1	-0 -0	-0 -0	-0 -0	-0	-0	0.
						1.40E+02 0.
						7.00E+01 0.

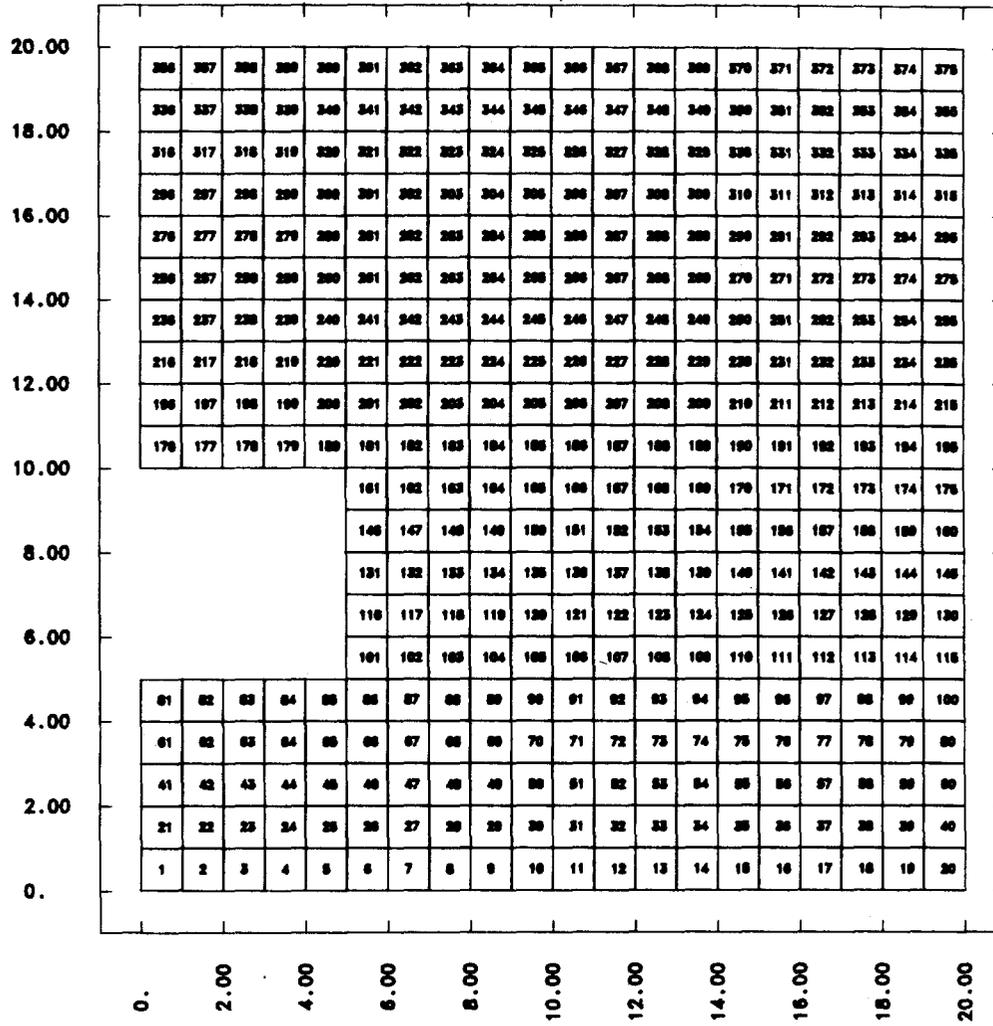
EXAMPLE FOR POSTACO  
MATERIAL OUTLINE



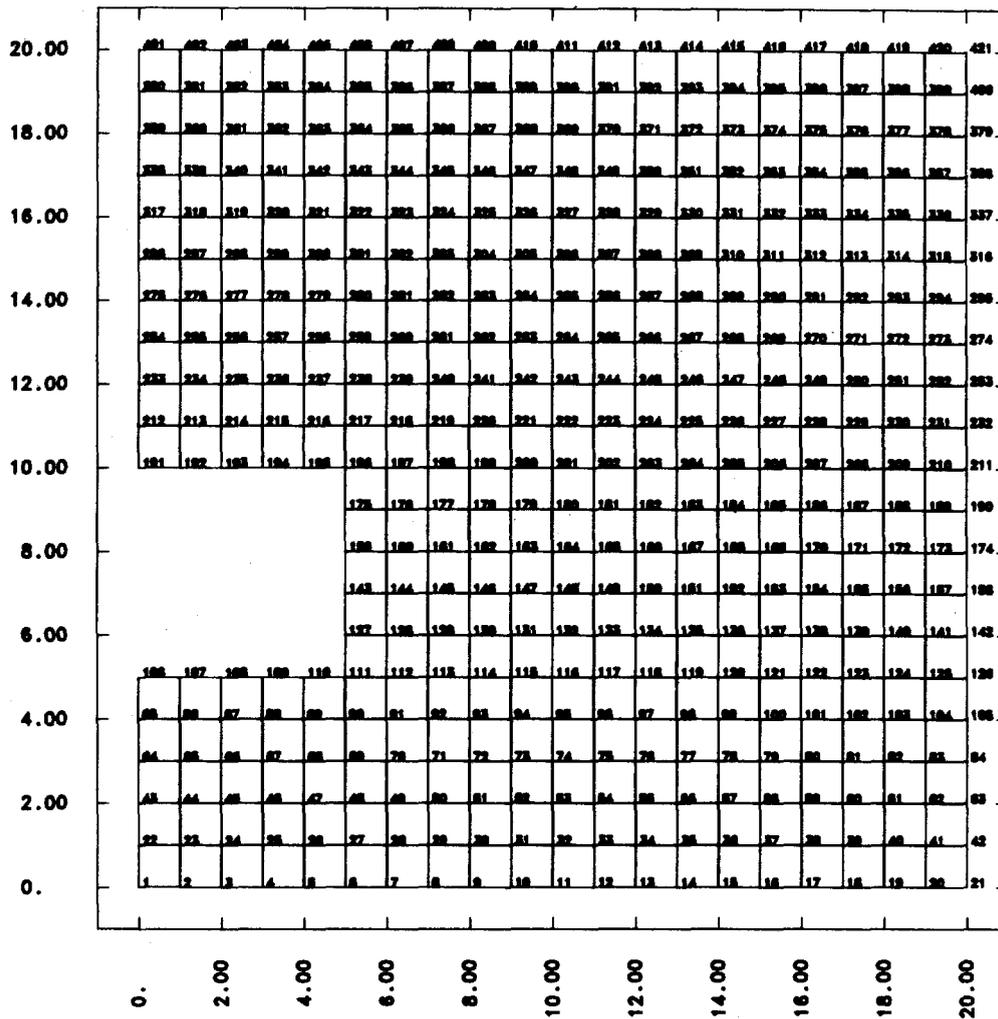
EXAMPLE FOR POSTACO  
MATERIAL NUMBERS



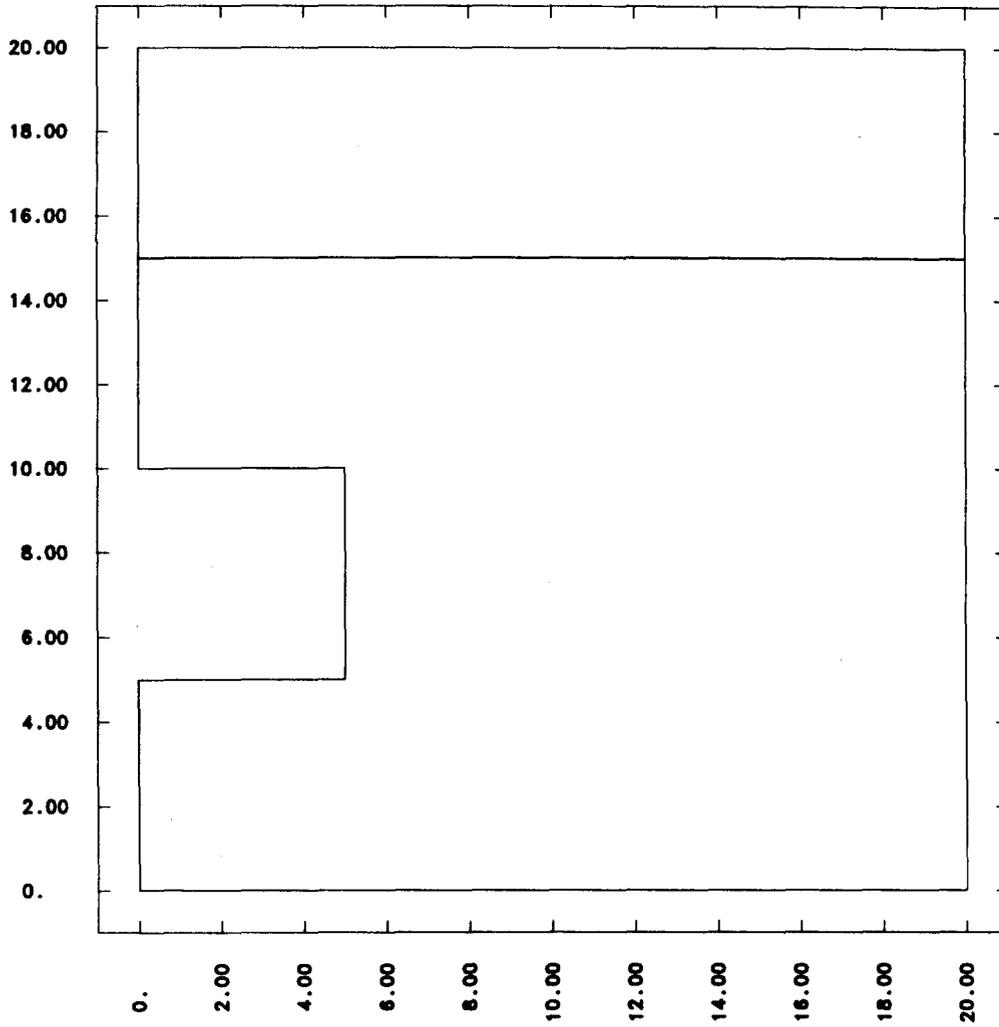
EXAMPLE FOR POSTACO  
ELEMENT NUMBERS



### EXAMPLE FOR POSTACO NODE NUMBERS



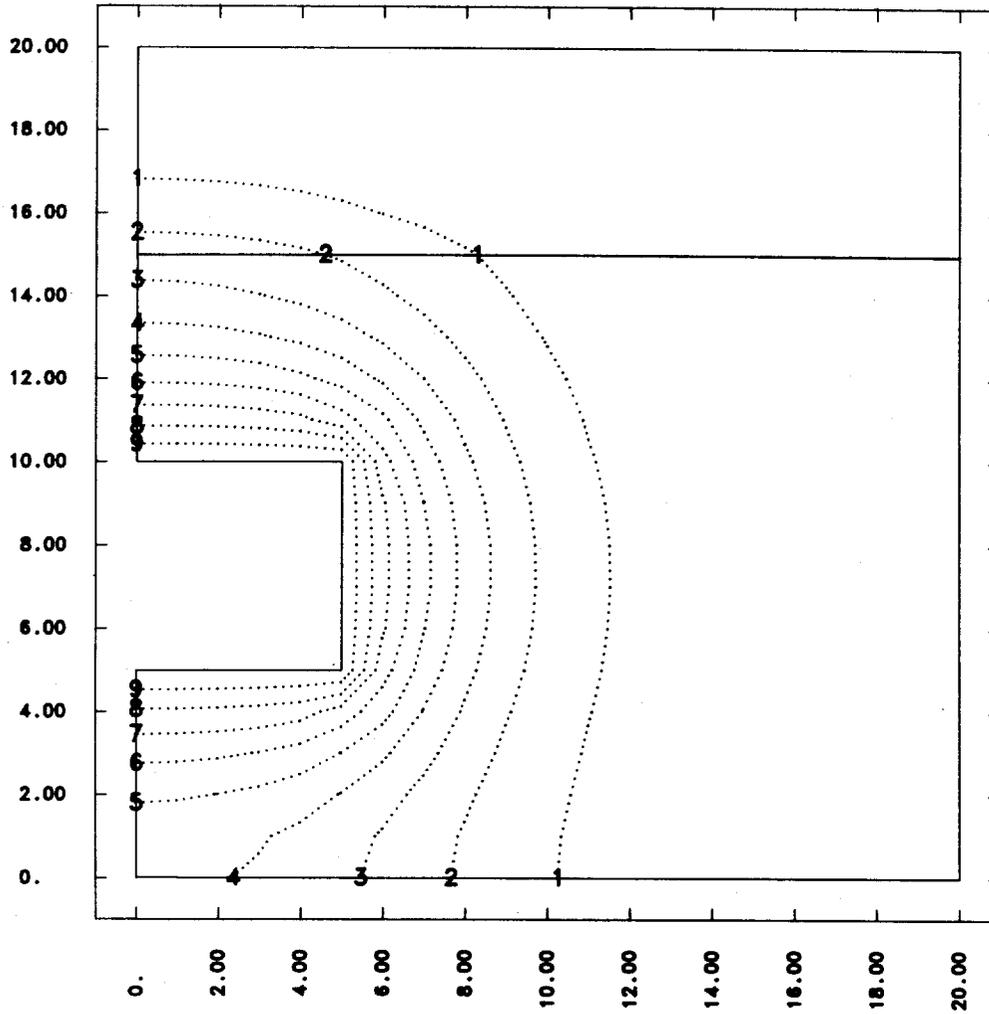
EXAMPLE FOR POSTACO  
ISOPLOT AT TIME 0.



CONTOUR LEVELS

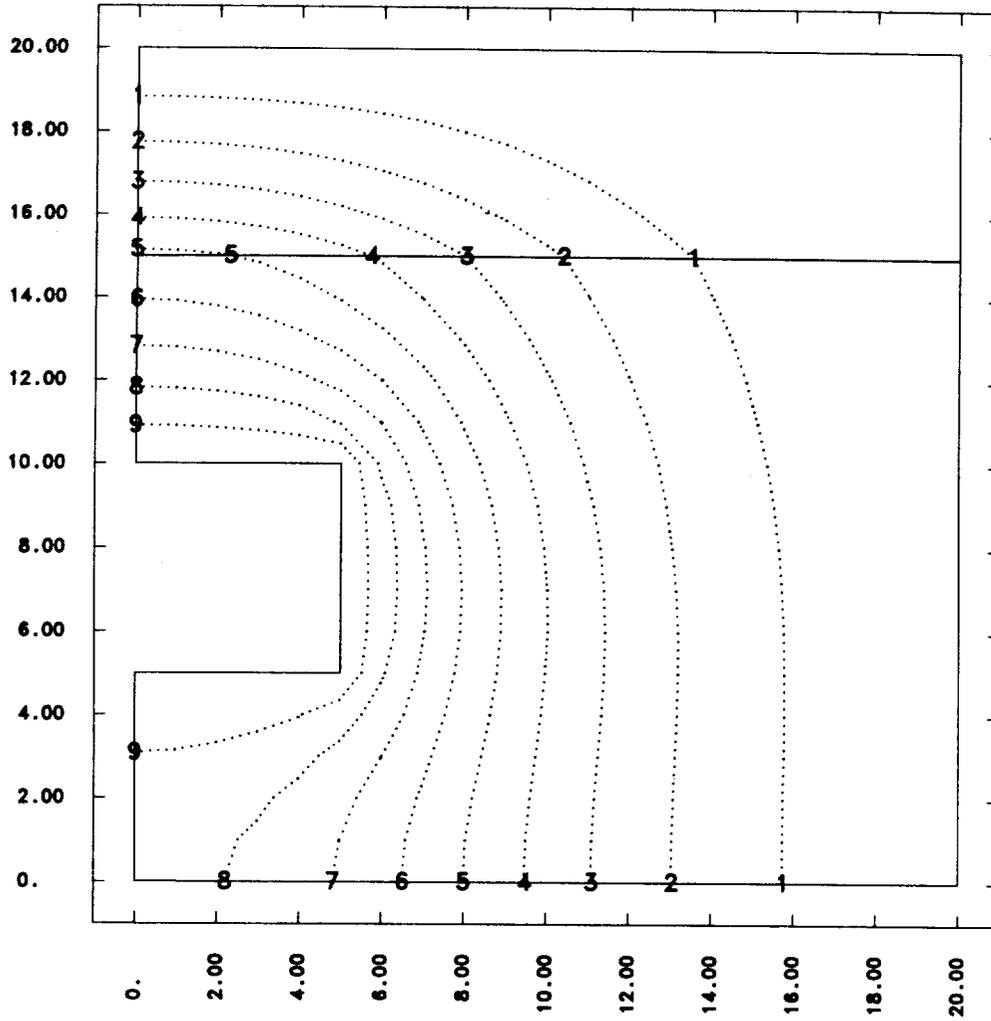
- 1 = 3.00E+01
- 2 = 4.00E+01
- 3 = 5.00E+01
- 4 = 6.00E+01
- 5 = 7.00E+01
- 6 = 8.00E+01
- 7 = 9.00E+01
- 8 = 1.00E+02
- 9 = 1.10E+02

EXAMPLE FOR POSTACO  
ISOPLOT AT TIME 5.0000E+00



CONTOUR LEVELS  
1 = 3.00E+01  
2 = 4.00E+01  
3 = 5.00E+01  
4 = 6.00E+01  
5 = 7.00E+01  
6 = 8.00E+01  
7 = 9.00E+01  
8 = 1.00E+02  
9 = 1.10E+02

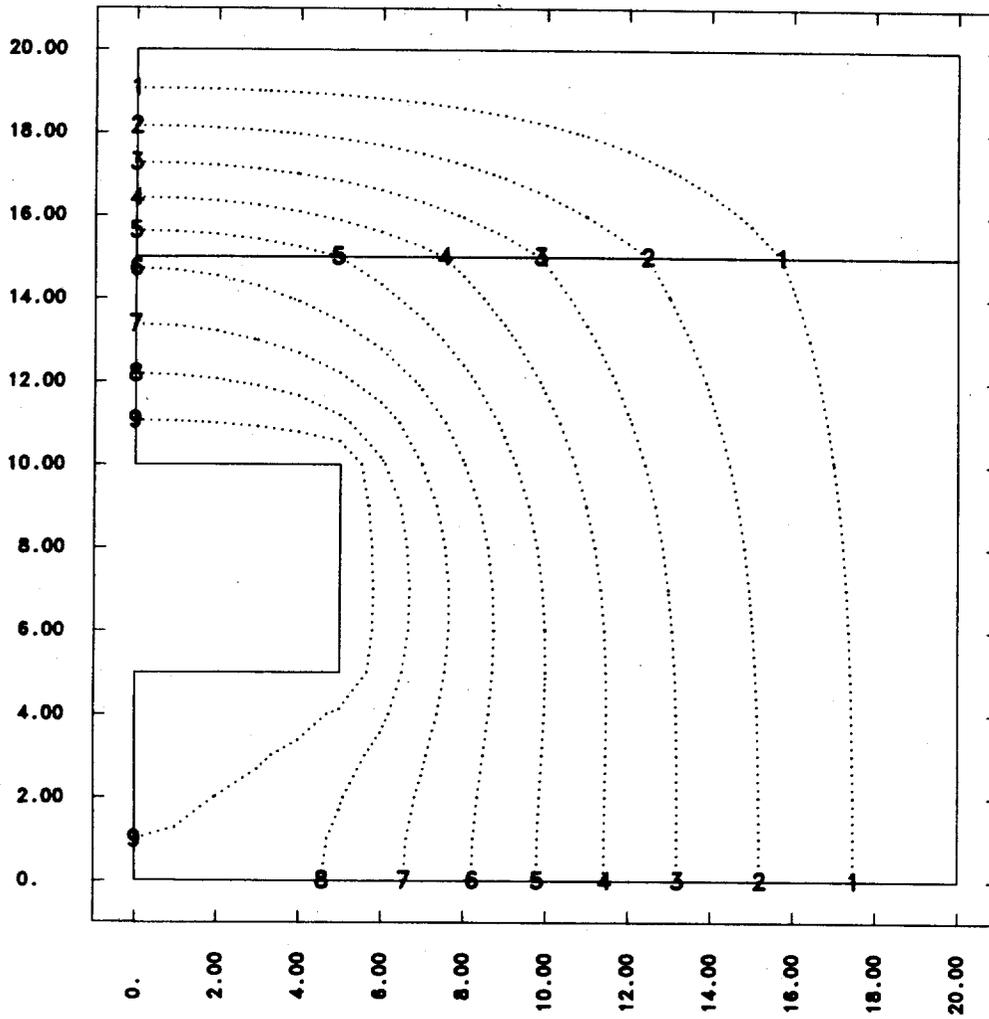
EXAMPLE FOR POSTACO  
ISOPLLOT AT TIME 1.0000E+01



CONTOUR LEVELS

- 1 = 3.00E+01
- 2 = 4.00E+01
- 3 = 5.00E+01
- 4 = 6.00E+01
- 5 = 7.00E+01
- 6 = 8.00E+01
- 7 = 9.00E+01
- 8 = 1.00E+02
- 9 = 1.10E+02

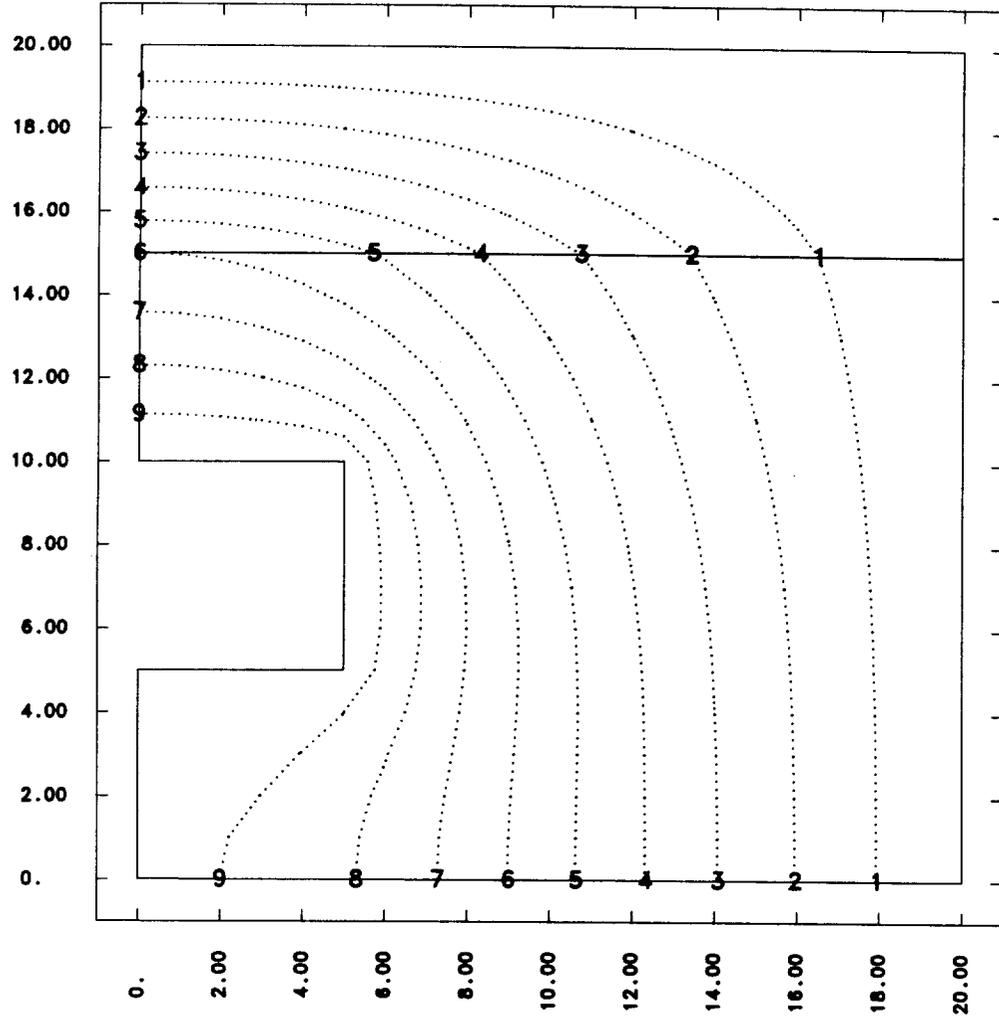
EXAMPLE FOR POSTACO  
ISOPLLOT AT TIME 1.5000E+01



CONTOUR LEVELS

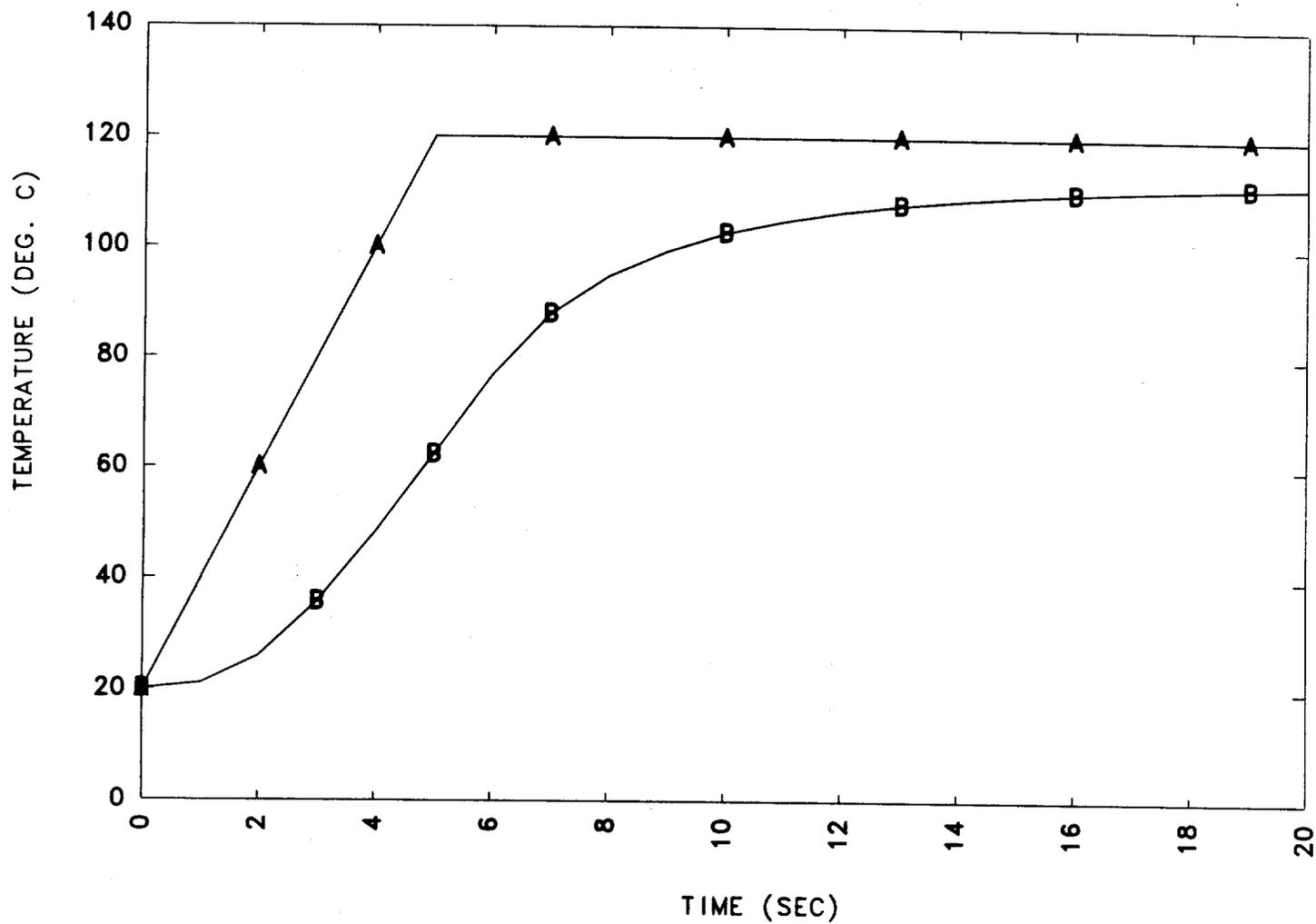
- 1 = 3.00E+01
- 2 = 4.00E+01
- 3 = 5.00E+01
- 4 = 6.00E+01
- 5 = 7.00E+01
- 6 = 8.00E+01
- 7 = 9.00E+01
- 8 = 1.00E+02
- 9 = 1.10E+02

EXAMPLE FOR POSTACO  
ISOPLLOT AT TIME 2.0000E+01



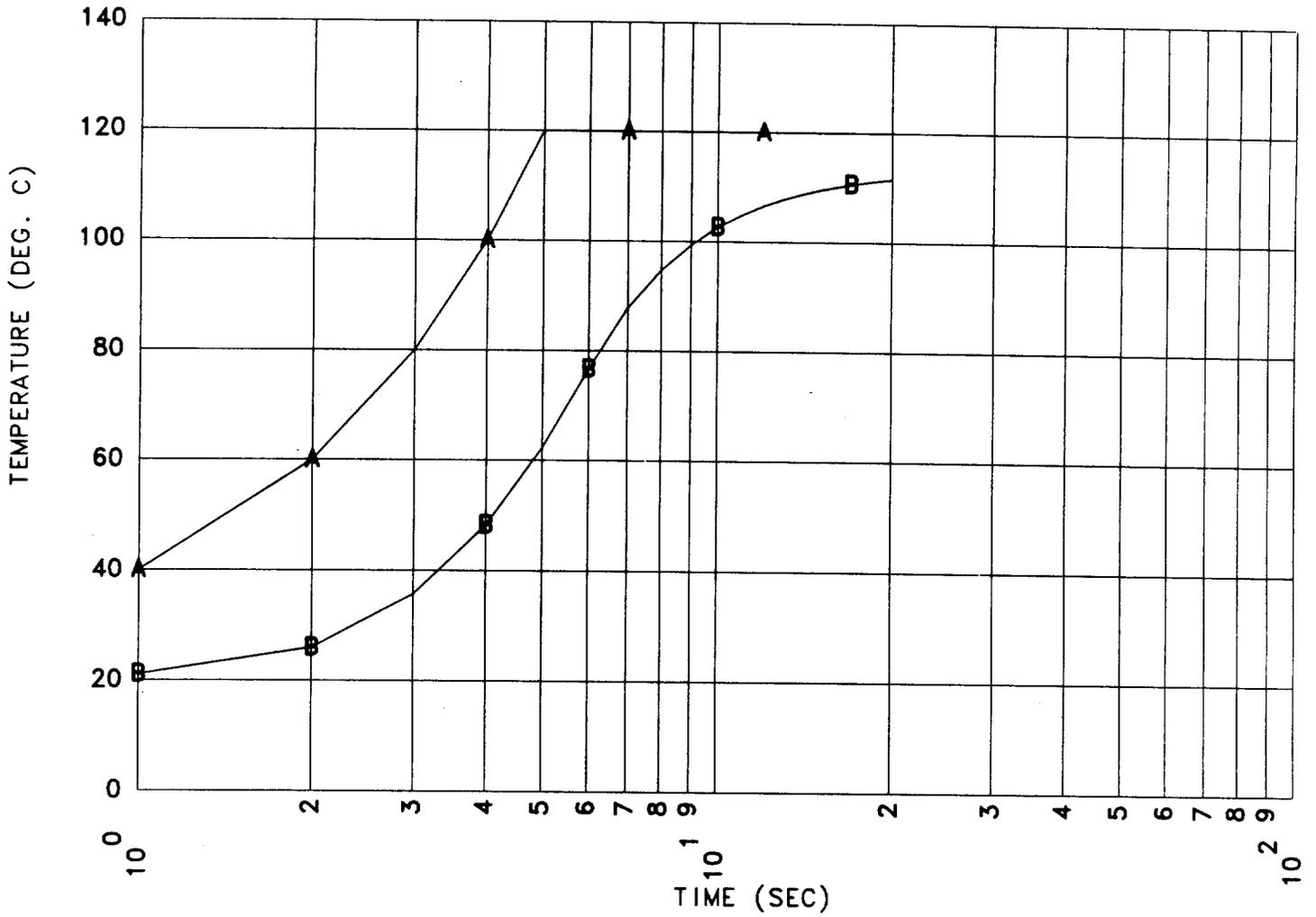
- CONTOUR LEVELS
- 1 = 3.00E+01
  - 2 = 4.00E+01
  - 3 = 5.00E+01
  - 4 = 6.00E+01
  - 5 = 7.00E+01
  - 6 = 8.00E+01
  - 7 = 9.00E+01
  - 8 = 1.00E+02
  - 9 = 1.10E+02

EXAMPLE FOR POSTACO



NODES: 106:A 1:B

EXAMPLE FOR POSTACO



NODES: 106:A 1:B

.....  
EXAMPLE FOR POSTACO

18:52:37U 10/21/78 TACO:V1. C:09/19/78  
.....

NODE 106. TIME HISTORY FOR TEMPERATURE (DEG. C)

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
0.	2.0000E+01	6.0000E+00	1.2000E+02	1.2000E+01	1.2000E+02	1.8000E+01	1.2000E+02
1.0000E+00	4.0000E+01	7.0000E+00	1.2000E+02	1.3000E+01	1.2000E+02	1.9000E+01	1.2000E+02
2.0000E+00	6.0000E+01	8.0000E+00	1.2000E+02	1.4000E+01	1.2000E+02	2.0000E+01	1.2000E+02
3.0000E+00	8.0000E+01	9.0000E+00	1.2000E+02	1.5000E+01	1.2000E+02		
4.0000E+00	1.0000E+02	1.0000E+01	1.2000E+02	1.6000E+01	1.2000E+02		
5.0000E+00	1.2000E+02	1.1000E+01	1.2000E+02	1.7000E+01	1.2000E+02		

.....

.....  
EXAMPLE FOR POSTACO

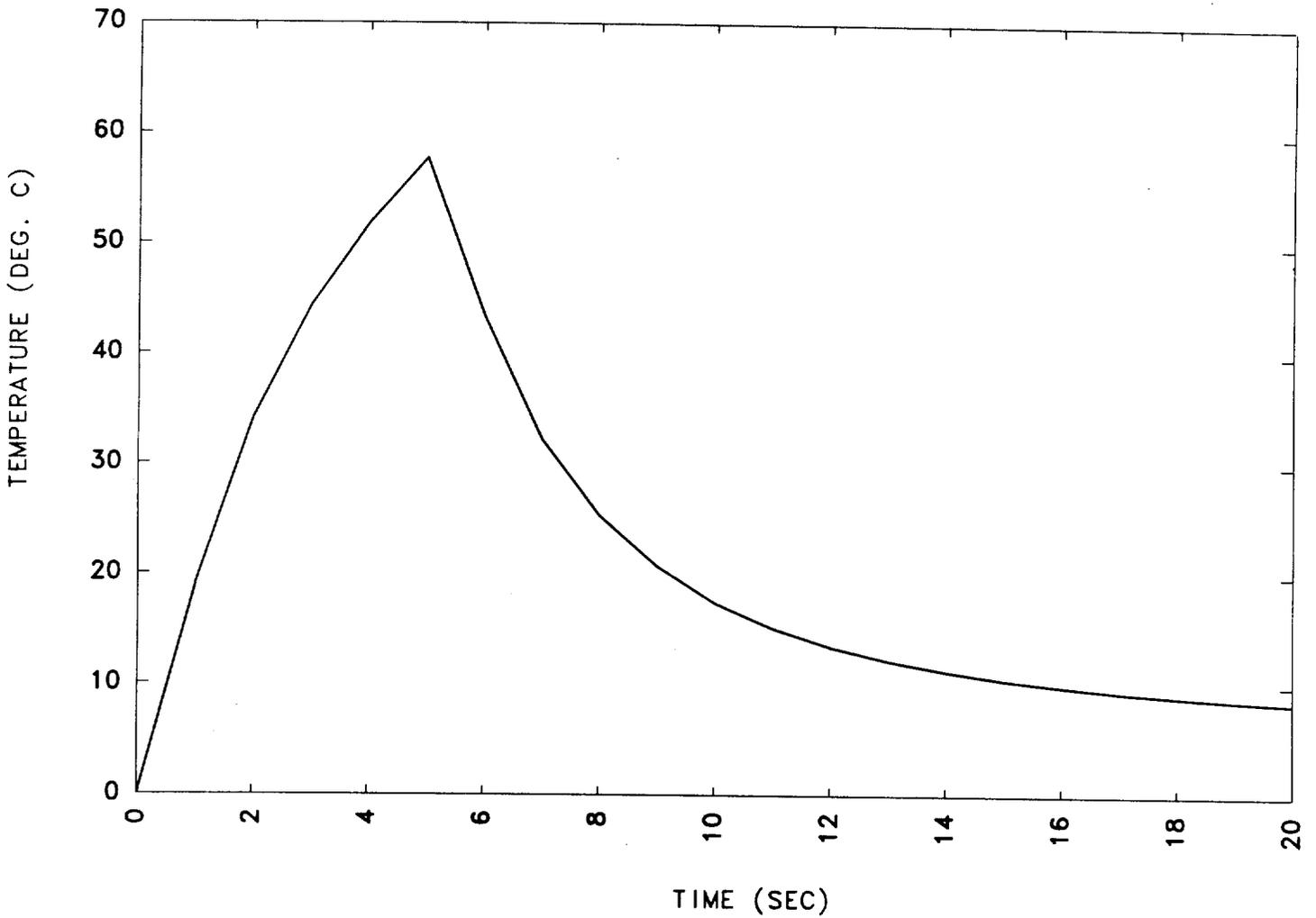
18:52:37U 10/21/78 TACO:V1. C:09/19/78  
.....

NODE 1. TIME HISTORY FOR TEMPERATURE (DEG. C)

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
0.	2.0000E+01	6.0000E+00	7.6635E+01	1.2000E+01	1.0657E+02	1.8000E+01	1.1097E+02
1.0000E+00	2.1040E+01	7.0000E+00	8.7817E+01	1.3000E+01	1.0782E+02	1.9000E+01	1.1130E+02
2.0000E+00	2.5941E+01	8.0000E+00	9.4731E+01	1.4000E+01	1.0877E+02	2.0000E+01	1.1156E+02
3.0000E+00	3.5724E+01	9.0000E+00	9.9313E+01	1.5000E+01	1.0952E+02		
4.0000E+00	4.8225E+01	1.0000E+01	1.0263E+02	1.6000E+01	1.1010E+02		
5.0000E+00	6.2296E+01	1.1000E+01	1.0487E+02	1.7000E+01	1.1059E+02		

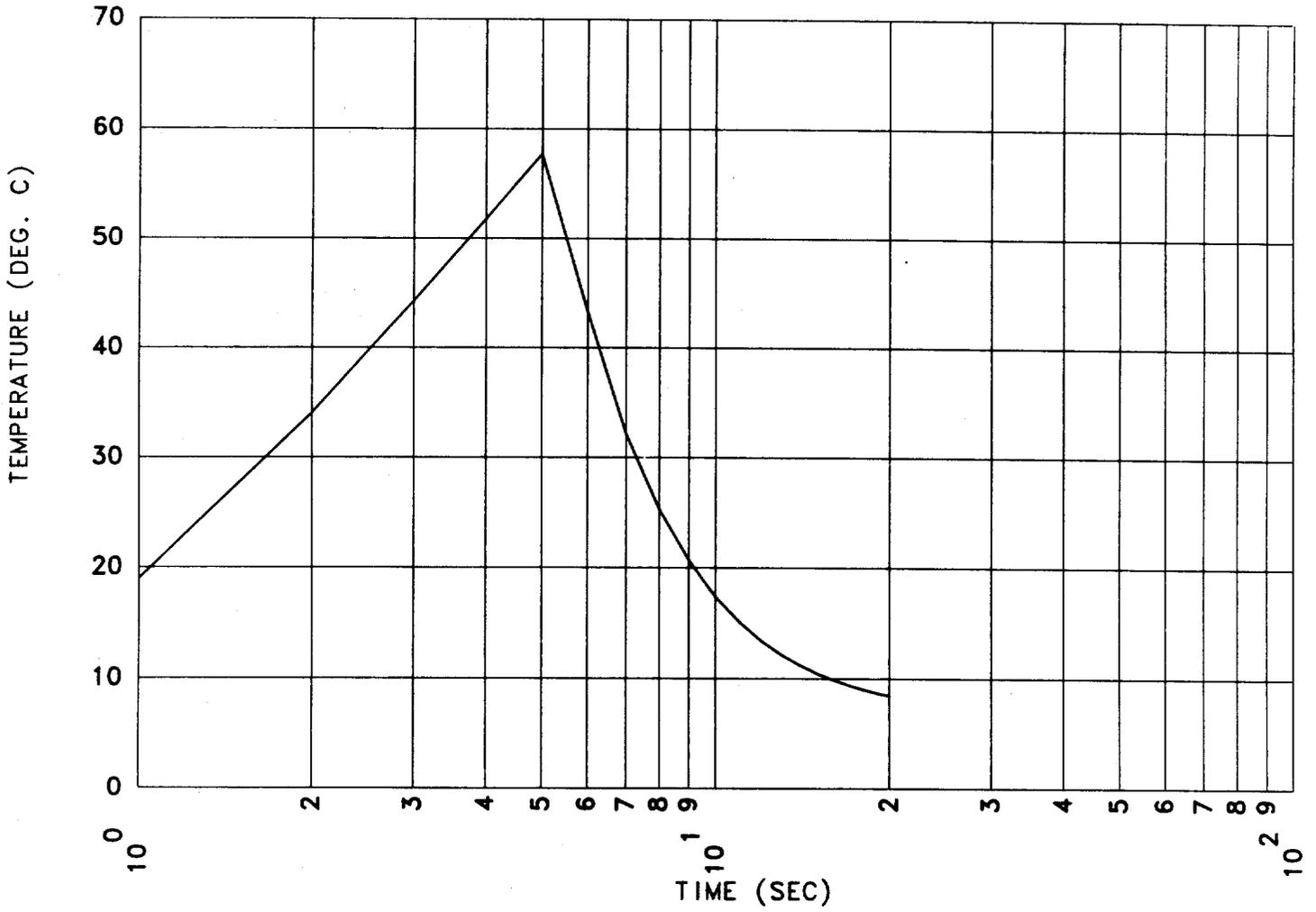
.....

EXAMPLE FOR POSTACO



DIFFERENCE BETWEEN NODE 106 AND NODE 1

EXAMPLE FOR POSTACO



DIFFERENCE BETWEEN NODE 106 AND NODE 1

.....  
EXAMPLE FOR POSTACO 18:52:37U 10/21/78 TACO:V1. C:09/19/78  
.....

NODES 106 AND 1. DIFFERENCE IN TEMPERATURE (DEG. C)

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
0.	0.	6.0000E+00	4.3365E+01	1.2000E+01	1.3427E+01	1.8000E+01	9.0311E+00
1.0000E+00	1.8960E+01	7.0000E+00	3.2183E+01	1.3000E+01	1.2183E+01	1.9000E+01	8.6993E+00
2.0000E+00	3.4059E+01	8.0000E+00	2.5269E+01	1.4000E+01	1.1231E+01	2.0000E+01	8.4430E+00
3.0000E+00	4.4276E+01	9.0000E+00	2.0687E+01	1.5000E+01	1.0475E+01		
4.0000E+00	5.1775E+01	1.0000E+01	1.7373E+01	1.6000E+01	9.8970E+00		
5.0000E+00	5.7704E+01	1.1000E+01	1.5129E+01	1.7000E+01	9.4067E+00		

.....

EXAMPLE FOR POSTACO

18:52:37U 10/21/78 TACO:V1. C:09/19/78

0 0 0 0 0 0 0 0 0 1 1

1.00E+00 1.00E+00 1.00E+00

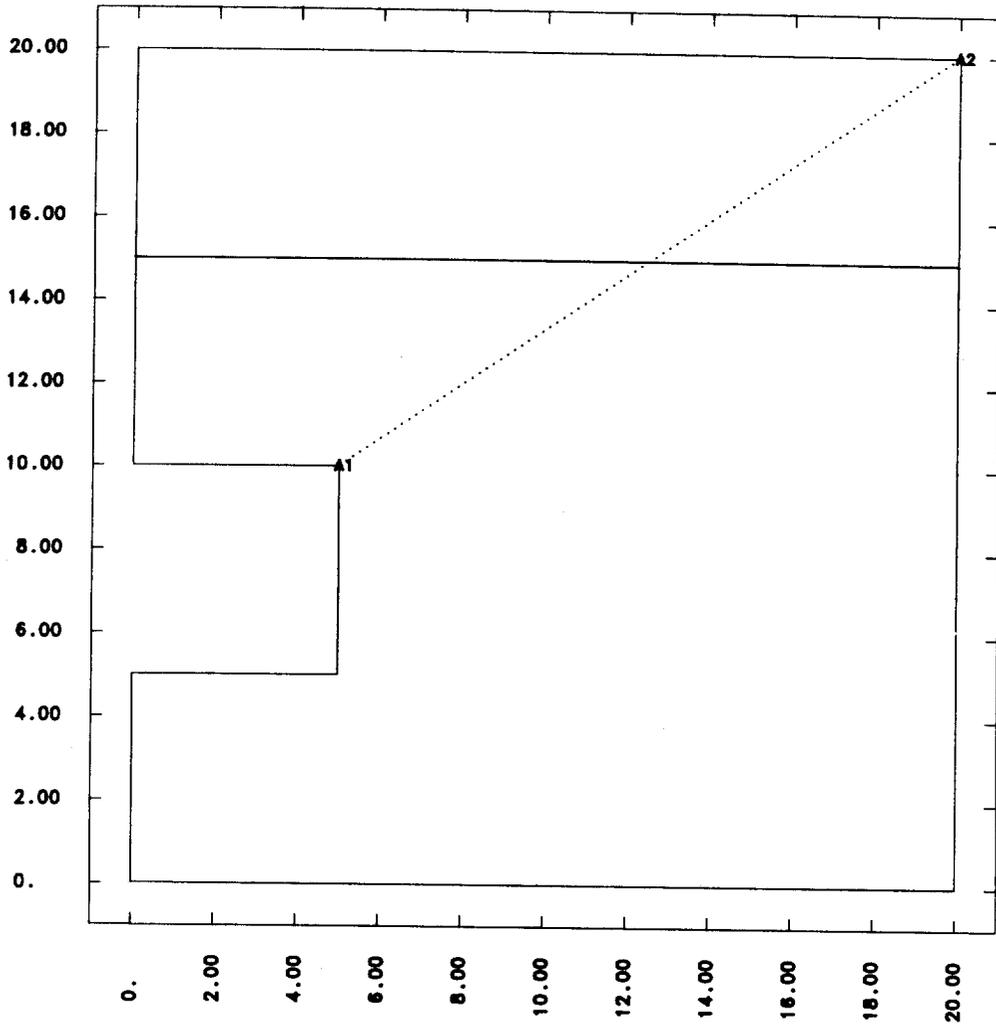
TIME (SEC) TEMPERATURE (DEG. C) DISTANCE (M)

1.00E+02 0. 0. 0. 0 0 0

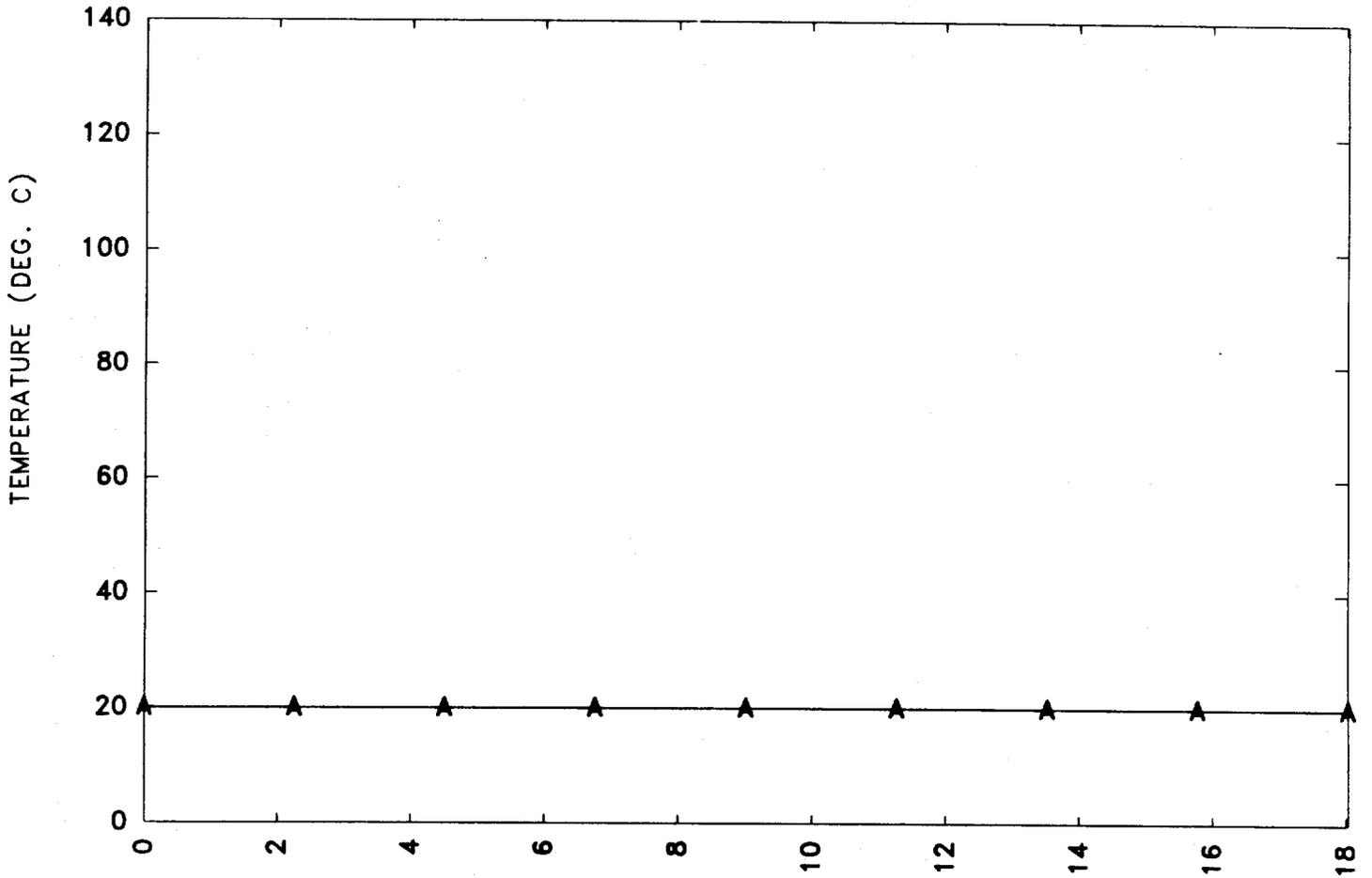
-1 5 0 0

196 421 0. 1.40E+02

EXAMPLE FOR POSTACO  
PROFILE PLOT GEOMETRY

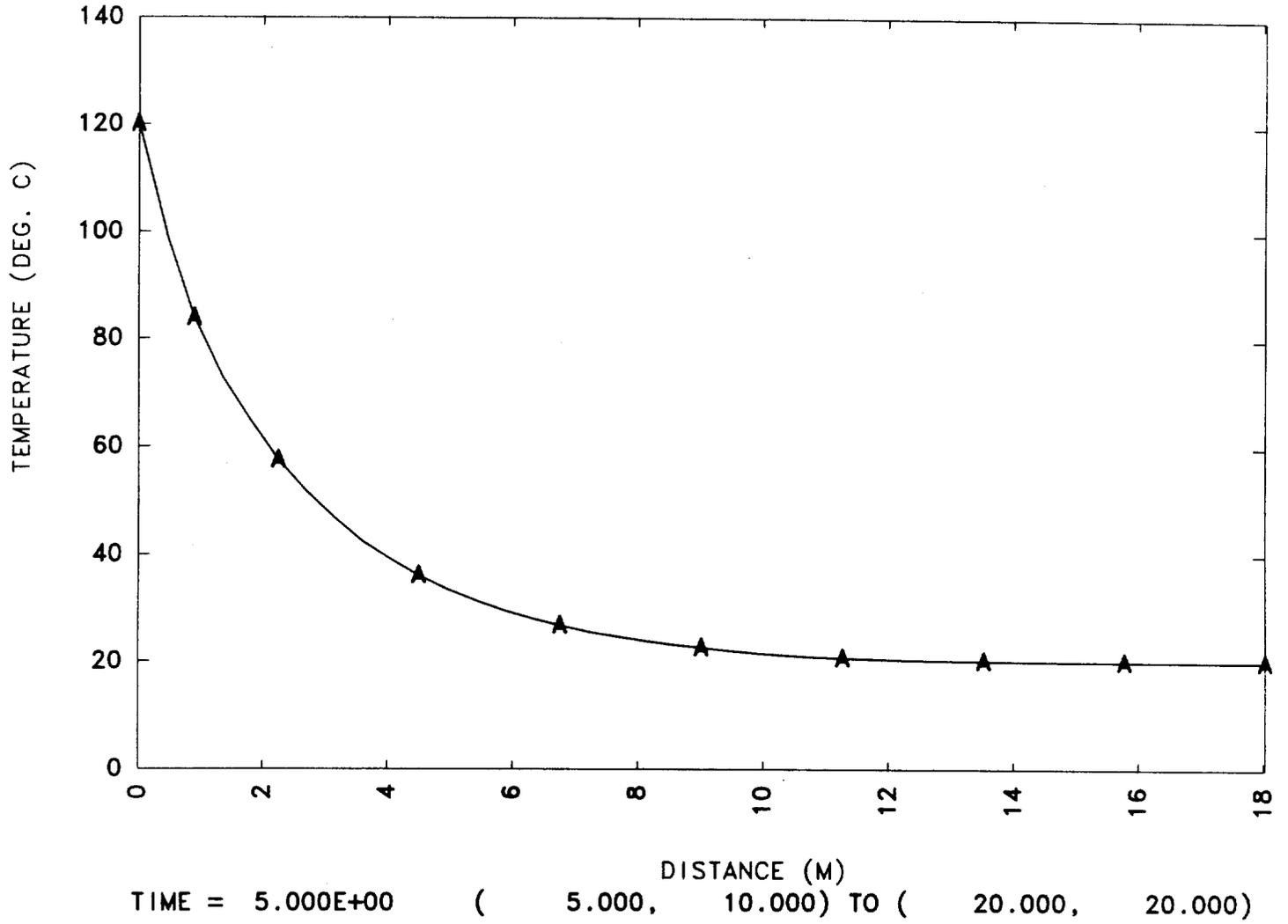


EXAMPLE FOR POSTACO

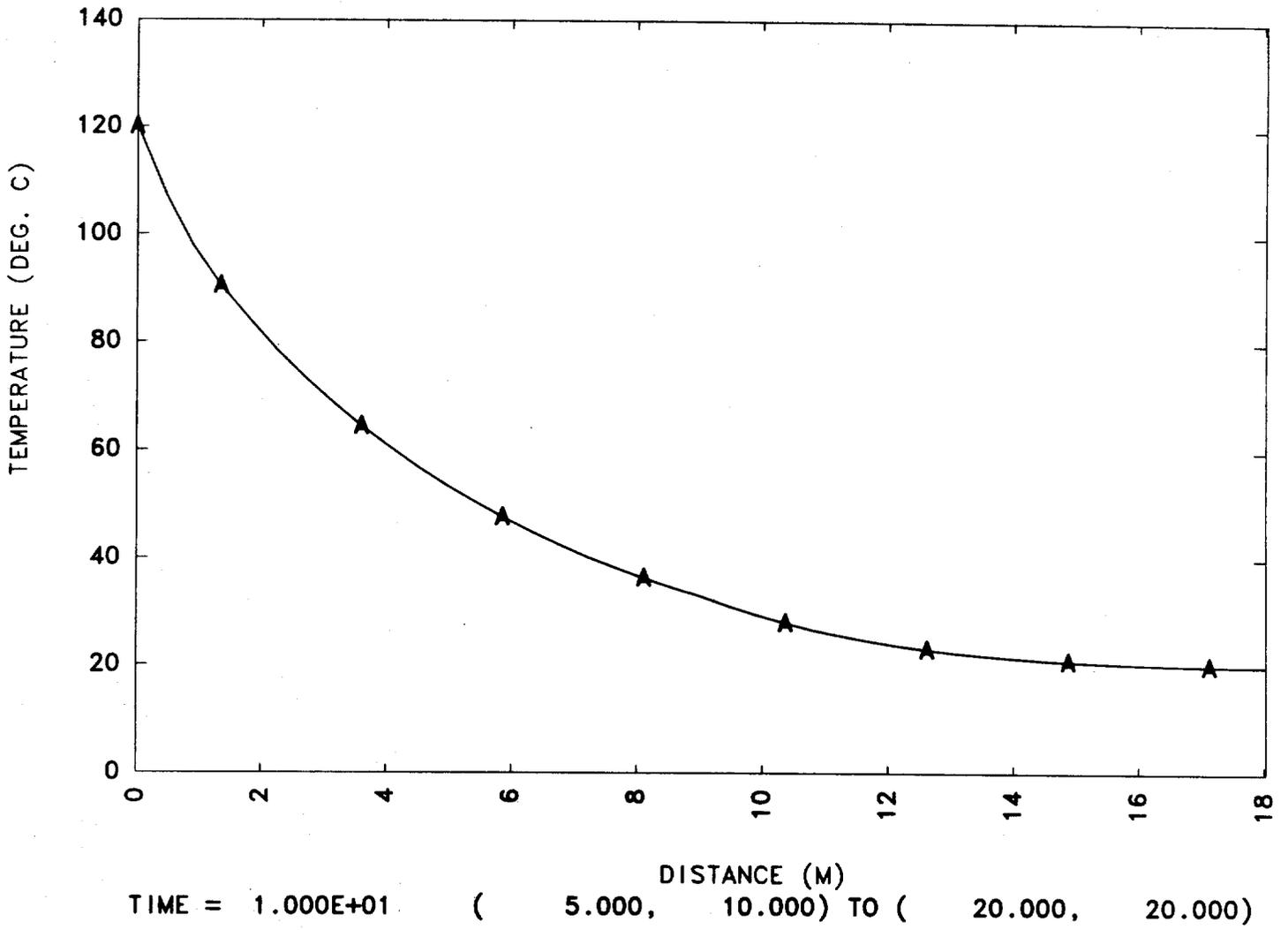


TIME = 0. ( 5.000, 10.000) TO ( 20.000, 20.000)

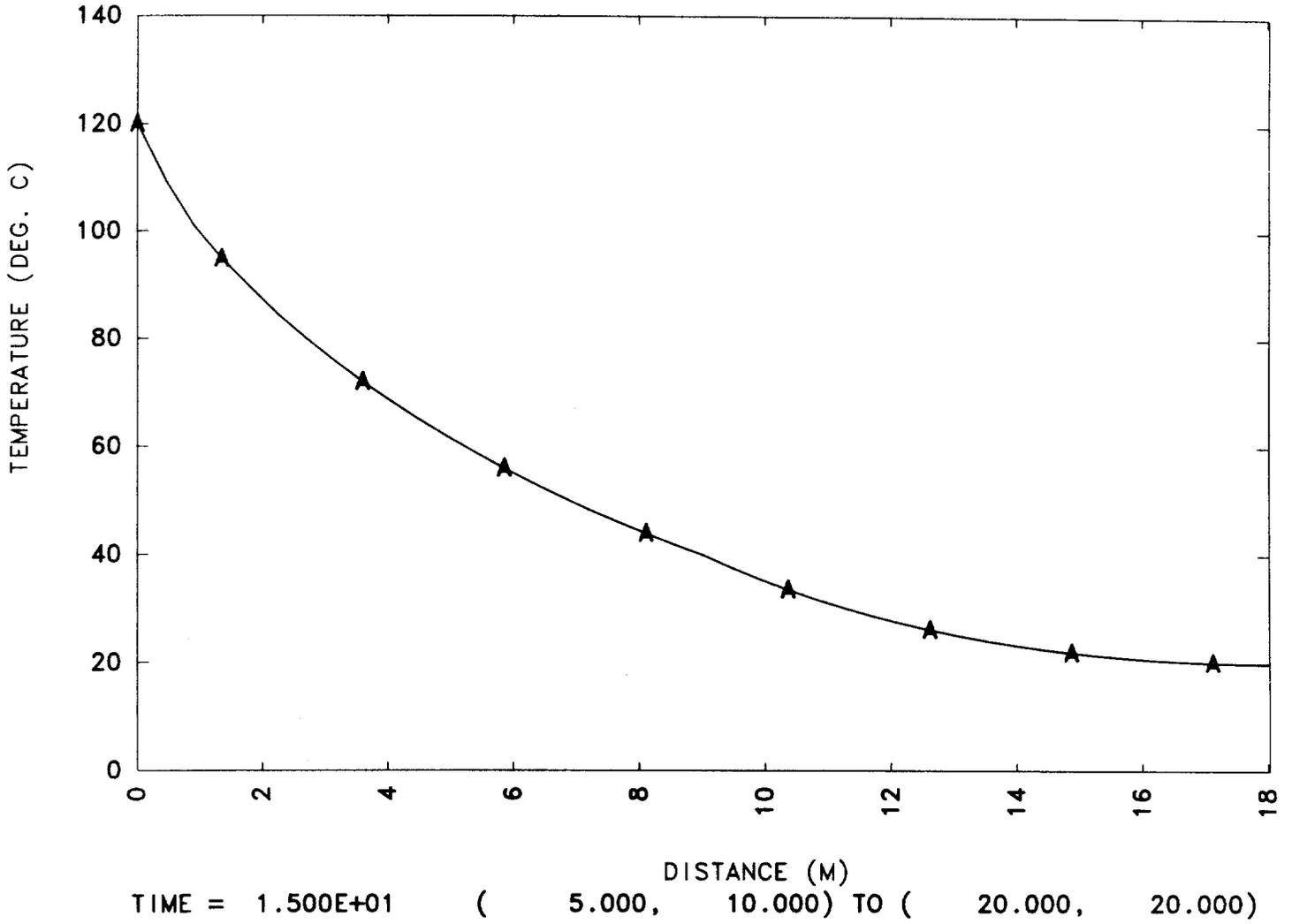
EXAMPLE FOR POSTACO



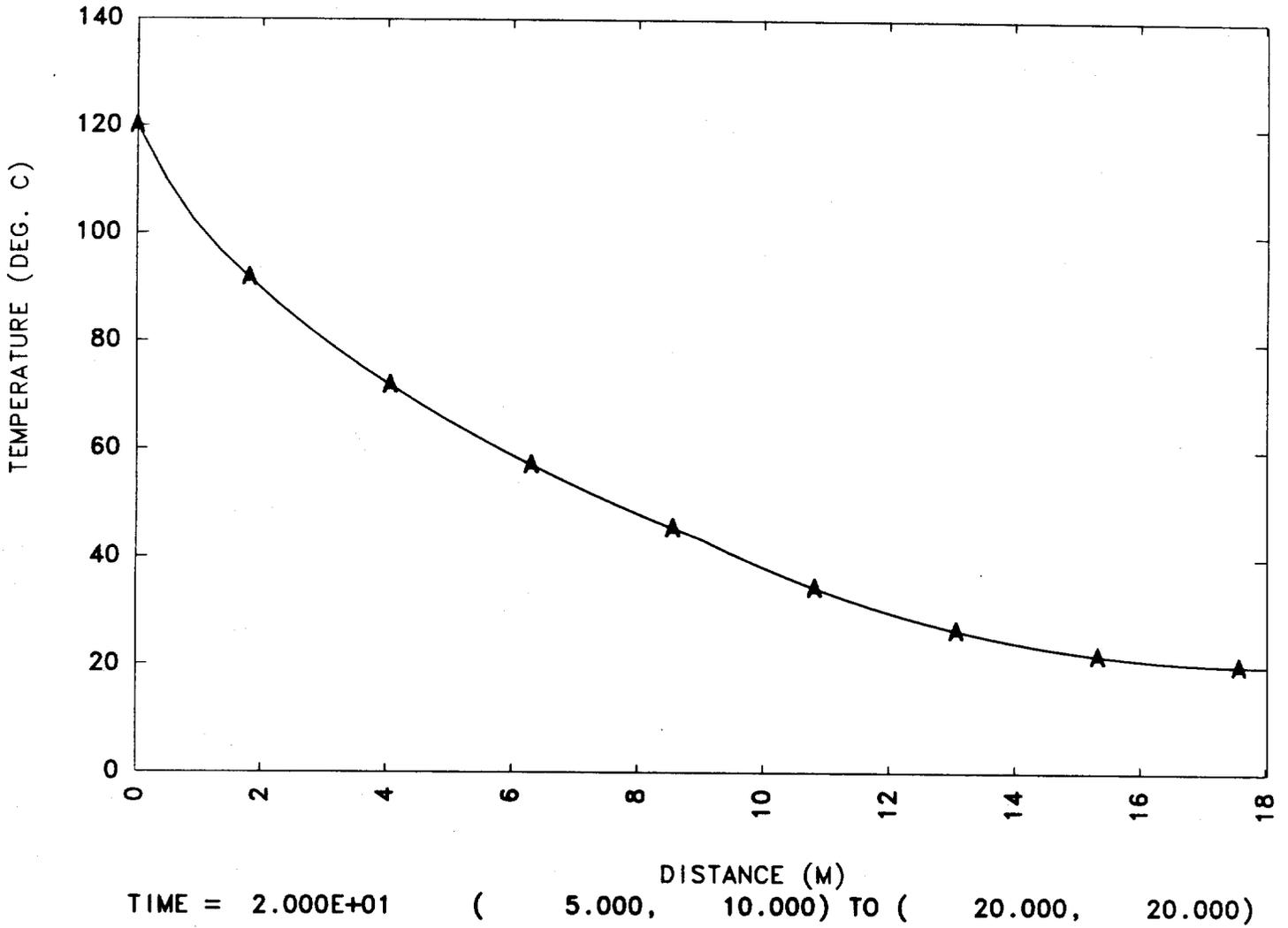
EXAMPLE FOR POSTACO



EXAMPLE FOR POSTACO



EXAMPLE FOR POSTACO



### ACKNOWLEDGMENT

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APPENDIX

PLOT FILE DATA BASE

As described in the section on execution, POSTACO reads a family of binary plot files. The format for these files is as follows:

CONTROL SECTION (64 Words)

<u>Word</u>	<u>Description</u>
1-6	Title of problem
7*	Time of day data was generated
8*	Machine designator and data of run
9-10*	Name and compilation data of code generating data
11	Dummy word
12	Number of nodal points (NUMNP)
13-19	Dummy words
20	Number of elements (NUMEL)
21	Number of materials (NUMATS)
22	Number of time states (NUMST)
23-64	Dummy words

GEOMETRY SECTION (2\*NUMNP+5\*NUMEL Words)

<u>Words</u>	<u>Description</u>
2*NUMNP	Array of nodal coordinates ( $x_1, y_1, x_2, y_2, \dots, x_{\text{NUMNP}}, y_{\text{NUMNP}}$ )
5*NUMEL	Element array ( $I_1, J_1, K_1, L_1, \text{MAT}_1, I_2, J_2, K_2, L_2, \dots, \text{MAT}_{\text{NUMEL}}$ — I, J, K, L = element node numbers, MAT = element material number)

\*These words are optional (i.e., they may be left blank).

PLOT FILE DATA BASE(cont'd.)

TIME STATE SECTION (NUMST\*(NUMNP+1) Words)

NUMST states written as follows:

<u>Words</u>	<u>Description</u>
1	Time
NUMNP	Nodal point functional values at this time.